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Abstract

The influence of sheep grazing on plant composition, canopy coverage, and forage utilization, was studied on an alpine range in northwestern Wyoming grazed by an unherded band of sheep and on an adjacent range where the sheep were grazed under the usual herded system. Under both systems total canopy coverage did not change appreciably over the 10 years of study. Alpine mat clovers, graminoids, and grasses were the preferred forages. Overall forage utilization was low; 6.1% on the range where the sheep were herded and 8.1% on the range grazed by the unherded sheep. Protecting range from sheep grazing influenced plant composition, but not total canopy coverage. The major response to protection from grazing was a decline in the coverage of alpine mat clovers, accompanied by an increase in the coverage of other forbs, especially non-cushion plant forbs. Lamb weight gains were similar under both grazing systems.

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John F. Thilenius

and

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INTRODUCTION

Sheep are the principal domestic grazing animal in the alpine zone of western North America (Thilenius 1975a). Historically and currently most sheep are grazed under the control of a herder. Thus, whether or not proper range management is applied depends to a great extent upon the experience and desire of the herder and upon the control exercised by the livestock owner and by the land management agency that administers the range.

Because qualified, responsible herders may be difficult to employ, herderless grazing has been advocated (Jones and Paddock 1966). Under this system the sheep are turned loose onto the range and allowed to distribute themselves and graze according to their own wants. Herderless grazing is not new. Jardine (1912) reported on a 5-year study on high mountain ranges in eastern Oregon, and the practice is normal in the mountains of New Zealand and Scotland. Advantages claimed for herderless grazing are better distribution of sheep over the range; minimal concentration on bedgrounds; decreased trailing damage; and better weight gains on lambs. Disadvantages are the need for fencing or natural barriers to limit unwanted movement (on alpine ranges, especially, fences may be expensive and difficult to build and maintain); increased possibility of predation; difficulty in collecting the sheep at the end of the grazing season; potential for grazing or bedding on areas that should be considered as nonrange, such as steep, easily eroded slopes, wet boggy areas below snowbanks, or riparian sites (Thilenius 1975a).

With these factors in mind, this study was initiated to determine if sheep could be successfully grazed on alpine ranges in northwest Wyoming without the continuous attention of a herder. Considered in the study were the influence of sheep grazing on range plant composition, canopy crown coverage, forage utilization, and lamb weight gains. These were recorded on an alpine range grazed by an unherded band of sheep and on an adjacent alpine range where sheep were grazed under a normal herded system. As an adjunct study, permanent sheep exclosures were established on each range to show how exclusion from sheep grazing influenced the vegetation.

STUDY AREA

The study was conducted on the eastern edge of the Absaroka Range at the eastern extreme of a long (ca. 32 km) northeast-southwest trending ridge of volcanic material known as Carter Mountain. The terrain of the study area is almost level to moderately steep. Slopes greater than 30% do occur, but none is inaccessible to sheep. Maximum elevation is 3445 m, but most of the range is below 3350 m. The total area of both allotments is approximately 1640 ha.

True alpine vegetation begins at 3050 m elevation. For the most part the alpine vegetation belongs to the turf and cushion plant physiognomic types. The plant communities, which are primarily examples of dry site alpine vegetation, and the soils have been described by Thilenius and Smith (1985).

Part of the dry condition of the range is due to its exposure to the prevailing westerly winds of winter, which leave much of the area snow-free. Compounding this is the fragmented nature of the volcanic substratum, which promotes good to excessive substrate drainage conditions throughout the range. The study site has no permanent bodies of water and only one mesic meadow about 10 ha in area. Small watercourses run full during the snowmelt period of May to mid-June, but during July and August there is little water in drainages except immediately after rainstorms. Even areas immediately below many of the long-lying snowbanks are not excessively moist throughout most of the summer. There are, however, several large permanent springs in the area. These originate in a band of volcanic ash exposed at the 3100-m level. Three water developments were built on this exposed aquifer to aid in the distribution of the unherded sheep band.

The entire range, which had been a Shoshone National Forest sheep allotment for many years under a herded management system, was subdivided for this study into two grazing allotments. The more eastern, referred to as the Carter Mountain allotment, was assigned to the unherded sheep band; the allotment used by the herded band was called the Meeteetse Creek allotment. Fences were constructed between the allotments to keep the unherded sheep out of Meeteetse Creek allotment and

on the Carter Mountain allotment to block the movement of the unherded sheep to the north. The western boundary of the Meeteetse Creek allotment was unfenced, but was marked by rock cairns to indicate to the herder the limits of the assigned grazing area.

METHODS

Grazing Systems

Sheep grazed the allotments between July 10 and September 8 (60 days). This is the normal grazing period for alpine grazing allotments on the Shoshone National Forest. The average length of time the sheep actually were in the alpine zone was closer to 50 days as they usually were moved to lower ranges soon after September 1. The sheep bands averaged 1200 ewes plus their lambs. As twin lambs were common, there were about 3000 animals in each band. The herded band was moved by the herder from a base camp at 2400 m to the alpine zone (+3050 m) in a single day. The unherded sheep were released at the 2400-m level, and normally reached the study area in a day. Unherded sheep remained at the highest elevations on the allotment for most of the grazing period.

Vegetation Sampling

Measurements of vegetation on the open range were made at 149 sites: 75 on the Meeteetse Creek allotment; 74 on the Carter Mountain allotment (one site was destroyed by a bulldozer during road construction for seismic oil exploration). Estimations were made in 1965, 1970, and 1975 in mid-July when the majority of the taxa were best developed.

At each site, canopy coverage was estimated on ten, 1x2-dm quadrats systematically located at 3-m intervals along a 30-m transect line. Estimation intervals were 10% for canopy coverage greater than 10%. Intervals of less than 1% and between 1% and 10% were used to estimate coverage below 10%. Estimations were made on the basis of plant groups. The plant groups were (1) geum, which consisted of only *Geum rossii*, the most obvious single taxon; (2) mat clovers (*Trifolium* spp.), which were the most heavily grazed taxa according to Strasia et al. (1970); (3) cushion forbs; (4) non-cushion forbs; (5) true grasses; and (6) graminoids (sedges, rush, and woodrush). The individual taxa included in each plant group are given in the Appendix. Specimens of all taxa encountered were collected and deposited in the herbarium of the Forest Range and Watershed Laboratory, Laramie, Wyo. Identifications were checked by the Forest Service Herbarium, Washington, D.C., and Fort Collins, Colo.

Utilization was estimated on the same 149 sites used to estimate canopy coverage, but twenty 4x8-dm quadrats were used. The utilization quadrats were spaced 1.5 m apart along a 60-m transect partly superimposed on the coverage estimation transects. A record was made of all of the taxa present on the quadrats whether utilized or not, but the amount of foliage removed was estimated only for the plant groups. Utilization was estimated in September as soon as possible after the sheep had left the range.

A more intensive study of the vegetation was conducted at a 30x30-m sheep exclosure in each allotment. Quadrat size and canopy coverage estimation techniques were the same as for the open range, but the number of quadrats was increased from 10 to 20 each, inside and outside the exclosures. The initial measurements of coverage inside the exclosures represent vegetation protected from grazing by sheep for one growing season.

The "outside exclosure" study sites were grazed by sheep. It is possible the presence of an artificial barrier in very open terrain attracted the unherded sheep, but we have assumed the intensity of use outside the exclosure was not biased by the presence of the fence.

Analysis of variance was used to test the statistical significance of differences in canopy coverage and utilization for the six plant groups. The 0.05 level was used to determine statistical significance.

Animal Performance

As an additional evaluation of the two grazing systems, the weight gain of a randomly selected sample of 100 lambs from each herd was determined. The lambs were ear-tagged and weighed to the nearest 0.45 kg (1 lb) at the beginning and end of the grazing season. Because the length of the season varied from year to year, gains were calculated as a daily average. Analysis of covariance was used to compensate for difference in initial weight. Statistical significance was 0.05.

RESULTS

Composition and Canopy Coverage

The taxa composition, physiognomy, and distribution of plants was sufficiently different between the two allotments to give the vegetation a generally different overall appearance. On the Meeteetse Creek allotment, the vegetation was somewhat taller and more lush than on the Carter Mountain allotment. The Meeteetse Creek allotment had a greater area of shaded lee slopes where long-lasting snowbanks were present. Consequently, a better supply of available water was present during the growing season. The Carter Mountain allotment was located at the end of an exposed, windswept ridge and large long-lasting snowbanks were uncommon.

Major Plant Taxa

Ninety-four taxa were recorded on 149 sampling sites (Appendix), but only eight taxa had an overall average canopy coverage that exceeded 2%. *Geum rossii* (11.4%), *Trifolium dasyphyllum* (9.8%), *T. nanum* (8.1%), *Poa* spp. (5.5%), *Carex obtusata* (3.5%), *Polygonum bistortoides*

(3.0%), *Arenaria obtusiloba* (2.6%), *Lomatium montanum* (2.1%). All are common in alpine tundra of northeastern Wyoming. The eight taxa provided 63% of the total canopy coverage of the combined allotments. The first three listed provided 40% of canopy coverage. Concentration of total plant abundance in a few taxa is common in alpine vegetation (Thilenius and Smith 1985).

The canopy coverage of *Poa* spp. is somewhat misleading. Three species (*P. alpina*, *P. rupicola*, and *P. cusickii*) were combined into one taxon because of general absence of flowers and consequent uncertain identification. *Koeleria cristata* (1.7%) had the greatest canopy coverage of all individual grass species. The grass *Deschampsia caespitosa*, which is considered to be a key species for the evaluation of condition and trend on alpine ranges in the Rocky Mountains (Schwan and Costello 1951), was rare on both allotments.

Plant Groups

In 1965, geum, non-cushion forbs, and graminoids had significantly higher canopy coverage on the Meeteetse Creek allotment, while cushion forbs had significantly greater canopy coverage on the Carter Mountain allotment (table 1). There were no differences in the canopy coverage of alpine mat clovers and grasses.

Canopy coverage of geum, grasses, and graminoids was statistically similar on the two allotments in 1970. The Meeteetse Creek allotment had a significantly greater canopy coverage only of non-cushion forbs. Alpine mat clovers and cushion forbs had significantly greater canopy coverage on the Carter Mountain allotment.

In 1975, the canopy of geum, non-cushion forbs, grasses, and graminoids was significantly greater on the Meeteetse Creek allotment. The Carter Mountain allotment had significantly greater canopy coverage of alpine mat clovers and cushion forbs.

Overall, the Meeteetse Creek allotment had the greater canopy coverage of geum, non-cushion forbs, and graminoids; the Carter Mountain allotment had significantly more alpine mat clovers and cushion forbs. Canopy coverage of grasses was the same on both allotments.

On the Meeteetse Creek allotment there were no statistically significant differences in the canopy coverage of the geum, alpine mat clover, cushion forb, and graminoids plant groups between the three sample periods. Grasses had a statistically significant higher canopy coverage at the middle sample period, but there was no statistically significant difference in grass canopy coverage between the first and last sample periods. The canopy coverage of non-cushion forbs did not change

Table 1.—Average percentage canopy coverage and standard deviation as estimated by plant groups on the Meeteetse Creek (herded) and Carter Mountain (unherded) allotments, 1965–1975.[1]

Year	Plant group	Meeteetse Creek		Carter Mountain	
		x	s	x	s
1965	Geum	12.5*	9.9	8.6	6.5
	Non-cushion forbs	20.6*	9.9	17.3	8.1
	Mat clovers	19.1	11.8	21.4	11.5
	Cushion forbs	6.1	4.7	8.2*	4.3
	Grasses	9.1	5.5	8.0	4.4
	Graminoids	7.9*	5.6	4.9	3.3
	All groups	75.3		68.4	
1970	Geum	12.9	9.9	10.7	7.6
	Non-cushion forbs	23.5*	13.3	9.0	7.5
	Mat clovers	17.7	11.5	23.3*	14.7
	Cushion forbs	6.7	5.2	11.8*	10.0
	Grasses	11.4	5.8	10.8	6.0
	Graminoids	9.0	7.1	7.5	5.8
	All groups	81.2		73.1	
1975	Geum	13.5*	9.9	10.3	7.1
	Non-cushion forbs	16.8*	11.1	10.0	7.7
	Mat clovers	15.5	10.9	20.6	13.6
	Cushion forbs	6.7	5.1	11.4*	5.9
	Grasses	8.3*	5.0	6.7	3.4
	Graminoids	7.3	4.7	4.3	3.1
	All groups	68.1		63.3	

**Statistically higher canopy coverage between allotments.*

[1]*Before study was started in 1965 both ranges had been grazed under a herded system for many years.*

significantly between the first and second sample periods, but it was significantly greater at the last sample period.

On the Carter Mountain allotment there were no significant changes in the canopy coverage of geum and alpine mat clovers. Non-cushion forbs and cushion forbs had significantly higher canopy coverage at the beginning of the study period than at both of the two later sample periods. Differences in canopy coverage of non-cushion forbs and cushion forbs between the two later periods were nonsignificant. Graminoid canopy coverage was significantly greater at the middle sample period, but no significant difference was present between the first and last sample periods. The canopy coverage of grasses also was significantly greater at the middle sample period than at the first and last periods and there was significantly greater canopy coverage of grasses at the initial sample period than there was at the last sample period.

Effects of Grazing

Forage Utilization

The estimates of forage utilization were made in mid-September after the sheep had left the range. Early fall snowstorms prevented estimation of utilization in 1968, 1970, 1971, and 1973.

Overall, mat clovers were the most utilized plant group, graminoids second, and grasses third (table 2). Non-cushion forbs and geum were ranked next. Utilization of geum was significantly greater on the Carter Mountain allotment. It was the only group to show a statistically significant difference in utilization between allotments. Very little use was recorded on cushion forbs, possibly for reasons similar to those given for non-cushion forbs and partly because their woody stems and prostrate growth form makes them unpalatable or ungrazeble.

Responses of Plant Groups

The responses of the six plant groups to protection from sheep grazing are shown in table 3. In general, the geum and non-cushion forb plant groups significantly increased canopy coverage when sheep grazing was eliminated. This was particularly true at the Meeteetse Creek exclosure, where these two plant groups were most abundant. Both significantly increased in canopy coverage on the grazed area at the Meeteetse Creek exclosure and on the protected area at the Carter Mountain exclosure.

The canopy coverage of the geum and non-cushion forb plant groups outside the Carter Mountain exclosure was so low it was impossible to determine any effect of grazing. The differences in canopy coverage of both plant groups between the inside and outside of the Carter Mountain exclosure were attributed to growing conditions, not grazing.

When not grazed, canopy coverage of the mat clover plant groups significantly decreased at the Meeteetse Creek exclosure. In the ungrazed site at the Carter Mountain exclosure mat clover canopy coverage was maintained. Mat clovers generally maintained canopy coverage under grazing. Although there was a statistically significant increase in canopy coverage of alpine mat clovers with grazing at the Meeteetse Creek exclosure and a significant decrease at the Carter Mountain exclosure, the absolute changes in canopy coverage were small.

At both exclosure sites the canopy coverage of cushion forbs fluctuated more and decreased when protected from sheep grazing. In the grazed sites, canopy coverage of cushion forbs was maintained at much the same levels. A very small, but statistically significant increase in canopy coverage of cushion forbs occurred on the grazed site at the Meeteetse Creek exclosure.

Although some statistically significant changes in the canopy coverage of grasses and graminoids did occur at both exclosure sites, there were no strong trends or large differences in canopy coverage on either grazed or ungrazed sites.

Lamb Weight Gains

The overall average weight gains of lambs were the same (0.14 kg/day) on both the Meeteetse Creek (herded

Table 2.—Average percentage occurrence and percentage utilization of plant groups on the Meeteetse Creek (herded) and Carter Mountain (unherded) allottments between 1965 and 1975.[1]

Plant group	Meeteetse Creek		Carter Mountain	
	Percent occurrence	Percent utilization	Percent occurrence	Percent utilization
Mat clovers	90	16.4	93	19.4
Graminoids	91	8.4	94	11.0
Grasses	88	5.0	92	8.6
Non-cushion forbs	56	3.7	64	5.2
Geum	68	2.4	81	5.8
Cushion forbs	7	0.1	9	0.3

[1]*Utilization was estimated after sheep had left the ranges. Not estimated 1968, 1970, 1971 and 1973 because all sites were covered by snow.*

Table 3.—Percent of canopy coverage of plant groups at the Meeteetse Creek and Carter Mountain exclosures, 1965, 1970, 1975.

Plant group	1965 Inside x̄	1965 Inside s	1965 Outside x̄	1965 Outside s	1970 Inside x̄	1970 Inside s	1970 Outside x̄	1970 Outside s	1975 Inside x̄	1975 Inside s	1975 Outside x̄	1975 Outside s
Meeteetse Creek Allotment (herded)												
Geum	15.5	4.0	9.0	3.0	14.1	5.4	14.4	5.9	18.3.	6.6	13.9	6.6
Non-cushion forbs	11.8	3.1	3.7	1.1	19.8	3.6	11.6	2.9	26.3	10.0	14.5	7.3
Mat clovers	24.9	6.2	15.1	6.0	20.6	6.0	19.0	5.4	14.8	5.5	18.9	10.1
Cushion forbs	6.3	2.1	5.5	1.6	1.3	1.3	5.3	2.2	4.3	1.7	7.5	3.2
Crasses	9.2	2.4	3.7	1.2	7.2	2.5	5.3	2.6	6.0	2.1	4.4	2.7
Graminoids	6.6	3.4	4.9	1.4	9.1	3.6	8.1	3.2	6.4	3.0	7.3	3.7
All groups	74.3	7.0	41.9	4.4	72.1	7.6	63.7	5.5	76.1	8.7	66.5	5.5
Carter Mountain Allotment (unherded)												
Geum	7.1	3.4	0.5	1.4	10.3	5.3	0.7	0.2	11.5	6.1	1.1	2.4
Non-cushion forbs	5.3	2.0	3.4	0.9	14.7	6.2	2.9	2.9	13.9	4.3	5.8	3.8
Mat clovers	15.9	6.8	18.6	5.2	14.0	7.6	13.5	3.7	12.6	5.6	15.6	8.8
Cushion forbs	11.7	4.2	13.1	5.2	4.4	2.9	12.6	3.6	7.8	3.6	17.1	9.1
Grasses	5.3	1.6	5.1	5.4	4.3	2.0	4.1	1.6	5.1	1.9	3.2	1.8
Graminoids	4.6	1.5	5.1	1.2	4.2	1.7	5.7	1.4	5.5	1.8	3.9	1.8
All groups	49.9	4.5	45.8	6.8	51.9	5.0	39.5	5.3	56.4	3.8	46.7	6.8

grazing) and Carter Mountain (unherded grazing) allotments. Lambs on the Meeteetse Creek allotment had significantly greater gains in 1965, 1970, and 1972, while lambs on the Carter Mountain allotment outgained those on Meeteetse Creek in 1967, 1974, and 1975. There were no significant differences in the remaining 5 years.

DISCUSSION

Total plant coverage on either of the two allotments did not change appreciably over the 10 years of study under either system of grazing. The slightly higher total canopy coverage on the range grazed under a herded system should be attributed to the slightly better growing conditions rather than to the grazing system. Although there is some difficulty in using measurements taken at periods widely separated in time to express trends, the patterns in total plant coverage were similar for both ranges. Changes in absolute coverage were not significantly large, and the growing conditions of the year the samples were obtained seemed to be more influential than the grazing systems.

Geum and alpine mat clovers were the most important plant group at all three sample periods on both ranges. A major compositional difference between the allotments was the greater coverage of alpine mat clovers on the Carter Mountain allotment where the sheep were unherded. The Carter Mountain allotment also had greater coverage of cushion plants. Non-cushion forbs had greater coverage on the Meeteetse Creek range.

Average utilization for all classes of forage was 6.1% on the range grazed by the herded sheep and 8.4% on the range grazed by the unherded band. These values are close to the 7% average use recorded on alpine ranges in Colorado by Paulsen (1960).

Only alpine mat clovers received more than light use and this plant group was the most important forage. Grasses and graminoids were less used than mat clovers but more than the other classes of forage. It should be kept in mind the growth form of grasses and graminoids lends itself to the detection of grazing more than does the growth form of most of the alpine forbs. Because non-cushion forbs were present when utilization was estimated it is probable utilization was underestimated for this plant group. Cushion forbs were little used. Most cushion forbs have rather low digestibility (Smith 1969) and may also be unpalatable to sheep.

The exclosures allowed the influence of protection from grazing on the vegetation to be determined. A general increase in total plant coverage inside the exclosures was accompanied by a distinct change in plant composition. The most important changes were the decrease in canopy coverage of alpine mat clovers when protected from grazing and an increase in the canopy coverage of non-cushion forbs.

Alpine mat clovers are very well adapted to sheep grazing, as are cushion forbs; however, in contrast to the mat clovers, this plant group was little utilized. Non-cushion forbs and geum generally showed an increase in coverage when protected from grazing. Grasses and graminoids did not change coverage under protection and also maintained their coverage under grazing.

Total plant coverage was either increased or at least maintained under both grazing management systems, and it is not possible to recommend one system over the other from the standpoint of the vegetation. Both systems provided levels of forage utilization that appear to be within allowable limits. Nor were there any strong differences in the weight gains of lambs grazed under the two systems. It appears that other factors, such as the

availability of herders or economics, may have to be used to select a grazing system on alpine sheep range.

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APPENDIX

Alphabetical list of scientific[1] and common names [2] of taxa collected.

Grasses

Agropyron scribneri Vasey	Scribner wheatgrass
Agropyron trachycaulum (Link) Malte	Slender wheatgrass
Agrostis idahoensis Nash	Idaho bent
Deschampsia caespitosa (L.) Beauv.	Tufted hairgrass
Festuca occidentalis Hook.	Western fescue
Festuca ovina L.	Sheep fescue
Festuca rubra L.	Red fescue
Hesperochloa kingii (S. Wats.) Rydb.	King spikefescue
Koeleria cristata (L.) Pers.	Prairie junegrass
Poa L.	Bluegrass
Poa alpina L.	Alpine bluegrass
Poa cusickii Vasey	Cusick bluegrass
Poa rupicola Nash	Timberline bluegrass
Trisetum spicatum (L.) Richt.	Spike trisetum

Graminoids (sedges and woodrush)

Carex albonigra Mack.	Blackandwhitescaled sedge
Carex aquatilis Wahl.	Water sedge
Carex bigeovii Torr.	Bigelow sedge
Carex ebenea Rydb.	Ebony sedge
Carex elynoides Holm.	Blackroot sedge
Carex obtusata Lilj.	Obtuse sedge
Juncus L.	Rush
Luzula spicata (L.) DC.	Spike woodrush

Cushion Forbs

Antennaria microphylla Rydb.	Littlehead pussytoes
Antennaria rosea (D.C. Eat.) Greene	Rose pussytoes
Arenaria congesta Nutt. ex T. & G.	Ballhead sandwort
Arenaria obtusiloba (Rydb) Fern.	Twinflower sandwort
Arenaria rubella (Wahlenb.) Smith	Sandwort
Eritrichium nanum var. *elongatum* (Rydb.) Cron.	Alpine forgetmenot
Phlox caespitosa Nutt.	Tufted phlox
Phlox multiflora A. Nels.	Flowery phlox
Phlox pulvinata (Wherry) Cron.	Mat phlox
Sedum lanceolatum Torr.	Lanceleaf stonecrop
Silene acaulis L.	Moss silene

Mat Clovers

Trifolium dasyphyllum T. & G.	Whiproot clover
Trifolium nanum Torr.	Dwarf clover

Non-Cushion Forbs

Achillea lanulosa Nutt.	Western yarrow
Agoseris glauca (Pursh) D. Dietr.	Pale agoseris
Androsace septentrionalis L.	Pygmyflower rockjasmine
Anemone patens L.	Spreading pasqueflower
Arnica fulgens Pursh	Orange arnica
Arnica latifolia Bong.	Broadleaf arnica
Artemisia scopulorum A. Gray	Alpine sagewort
Aster alpigenus (T. & G.) A. Gray	Aster
Aster alpinus L.	Alpine aster
Aster foliaceous Lindl.	Leafybract aster
Astragalus alpinus L.	Alpine astragalus
Besseya wyomingensis (A. Nels.) Rydb.	Wyoming kittentails
Calochortus Pursh	Mariposalily
Campanula uniflora L.	Singleflower bellflower
Castilleja rhexifolia Rydb.	Splitleaf indianpaintbrush
Castilleja sulphurea Rydb.	Sulfur indianpaintbrush
Cerastium arvense L.	Starry cerastium
Cirsium polyphyllum (Rydb.) Petr.	Manyleaved thistle
Claytonia lanceolata Pursh	Lanceleaf springbeauty

Crepis nana Richards.	Tiny hawksbeard
Crepis runcinata (James) T. & G.	Dandelion hawksbeard
Delphinium nelsonii Greene	Nelson larkspur
Dodecatheon conjugens Greene	Sailorscap shootingstar
Dodecatheon radicatum Greene	Southern shootingstar
Draba spectabilis Greene	Showy draba
Epilobium alpinum L.	Alpine willowherb
Erigeron compositus Pursh	Fernleaf fleabane
Erigeron simplex Greene	Oneflower fleabane
Erigeron ursinus D.C. Eat.	Bearriver fleabane
Eriogonum flavum Smal!	Yellow wildbuckwheat
Galium boreale L.	Northern bedstraw
Geum rossii (R. Br.) Ser.	Alpine avens
Geum triflorum Pursh	Threeflower avens
Habenaria dilata (Pursh) Hook	White bogorchid
Lewisia pygmaea (A. Gray) Robins.	Least lewisia
Lomatium montanum C. & K.	Mountain lomatium
Lupinus monticola Rydb.	Lupine
Mertensia alpina (Torr.) G. Don	Alpine bluebells
Mertensia ciliata (James) G. Don	Mountain bluebells
Myosotis alpestris Schmidt	Alpine forgetmenot
Oxytropis parryi A. Gray	Parry loco
Pedicularis goenlandica Retz.	Elephanthead lousewort
Pecicularis parryi A. Gray	Parry lousewort
Penstemon procerus Dougl.	Littleflower penstemon
Phacelia Juss.	Phacelea
Polemonium viscosum Nutt.	Sticky polemonium
Polygonum bistortoides Pursh	Americanbistort knotweed
Potentilla diversifolia Lemn.	Platte cinquefoil
Ranunculus pygmaeus Wahl.	Pygmy buttercup
Rumex acetosa L.	Garden sorrel
Sagina saginoides (L.) Britt	Arctic pearlwort
Saxifraga rhombidea Greene	Diamondleaf saxifrage
Sedum rhodanthum A. Gray	Rosecrown stonecrop
Senecio fremontii T. & G.	Fremont groundsel
Sibbaldia procumbens L.	Sibbaldia
Solidago ciliosa (A. Gray) A. Nels	Fringed goldenrod
Taraxacum officinale L.	Common dandelion
Trifolium parryi A. Gray	Parry clover

Shrubs

Dryas octopetala L.	White mountain dryad
Potentilla fruticosa L.	Shrubby cinquefoil
Ribes cernum Dougl.	Mountain gooseberry
S. reticulata ssp. *nivalis* Hook.	Netleaf willow

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[1]*Scientific names follow Harrington (1954).*
[2]*Common names follow Beetle (1970).*

Rocky Mountains

Southwest

Great Plains

U.S. Department of Agriculture
Forest Service

Rocky Mountain Forest and Range Experiment Station

The Rocky Mountain Station is one of eight regional experiment stations, plus the Forest Products Laboratory and the Washington Office Staff, that make up the Forest Service research organization.

RESEARCH FOCUS

Research programs at the Rocky Mountain Station are coordinated with area universities and with other institutions. Many studies are conducted on a cooperative basis to accelerate solutions to problems involving range, water, wildlife and fish habitat, human and community development, timber, recreation, protection, and multiresource evaluation.

RESEARCH LOCATIONS

Research Work Units of the Rocky Mountain Station are operated in cooperation with universities in the following cities:

Albuquerque, New Mexico
Flagstaff, Arizona
Fort Collins, Colorado*
Laramie, Wyoming
Lincoln, Nebraska
Rapid City, South Dakota
Tempe, Arizona

*Station Headquarters: 240 W. Prospect St., Fort Collins, CO 80526